Virtual Part-task Trainer for Close Air Support Leveraging COTS

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ABSTRACT

Close Air Support (CAS) operations are conducted in highly demanding, dynamic environments. The effectiveness of the ground scheme of maneuver and the safety of its participants often relies on critical decisions made by the aviators in the air. Two factors have been identified as the most critical for the success of CAS missions: communication between the Joint Terminal Attack Controller or Forward Air Controller and the Close Air Support provider, and the capabilities of the pilot/CAS platform. In typical CAS missions, both missing and incorrect information conveyed via the communication channel has to be detected and immediately rectified while the pilot is operating the aircraft - this puts very stringent performance requirements on pilots. Training for CAS operations is therefore complex and time consuming. Current training approaches observe Cognitive Load Theory and a scaffolding approach, and guide trainees through a series of part-task training opportunities. This paper focuses on the two critical factors - the communications (practiced through instructor-driven 'chalk-talk' sessions) and procedures. As the number of available instructors is limited, currently perceived training needs are directed towards a stand-alone, part-task trainer that allows self-paced practice of standardized communication commands. The paper details our efforts in developing such a system: it includes task analysis, survey of the user domain, design and development of prototype system using commercial-off-the-shelf technologies, and a feasibility study with a review of system performance and an informal test with experts. The developed prototype trainer addresses the issues identified in the survey and adds technology-enabled training capabilities beyond traditional practices. An added level of real-time visual and auditory feedback supports effective acclimatization to the actual task and enables more realistic user interactions. We believe that once fully developed, this approach holds the promise of providing more effective training while preserving all the advantages of a part-task trainer.

ABOUT THE AUTHORS

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Dr. Amela Sadagic is a computer scientist and a Research Associate Professor at the Naval Postgraduate School (NPS), Modeling Virtual Environments and Simulation (MOVES) Institute, Monterey, CA, with a professional research career spanning 29 years. She has been a PI and co-PI on numerous research efforts at NPS that were supported by close to $10M in funding, and involved over 4500 USMC and USN personnel as subjects in user studies. In the past she was Director of Programs at Advanced Network and Services Inc. where she designed and led programs focused on the use of emerging technologies in learning. She was also responsible for the coordination of a research consortium "National Tele-immersion Initiative (NTII)" that involved 30 researchers from leading US

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INTRODUCTION

A number of tasks conducted by human operators involve a complex skill set that humans need to master. This is particularly the case in the military domain where the operational environment is highly demanding, dynamic and with stringent performance requirements on the part of the operator. Training approaches and systems that are used to acquire and perfect such complex skills typically include classroom instruction, individual study, computer supported training solutions, often including large simulators, and training sessions in environments that are as similar to the targeted operational environments as possible; good examples of the latter are physical training ranges that afford trainees the opportunity to practice skills in their integrated form. Considerable care is invested to make sure that the trainees are ready for the next training evolution i.e. that they have all the skills at the requested levels that will be needed in the next training evolution. As those training solutions are used for extended periods of time and by a large number of trainees, domain practitioners have the opportunity to acquire more detailed understanding about the effectiveness of each training solutions training gaps that may exist between two training evolutions.

The training methods currently used in support of Close Air Support (CAS) operations include a variety of classroom approaches conducted with and without instructors (examples: classroom lectures, 'chalk talks, 'chair flying'), followed by multiple training events that employ a flight simulator, and lead up to flight events in the aircraft. The number of acquired skills and the proficiency level that is expected between the two consecutive types of training can be considerable. This is especially characteristic of the Pilots Under Instruction (PUIs) after they complete ground-school type training sessions and before they embark on training with a flight simulator; it is also not uncommon that PUIs feel a need for additional training before their first CAS flight in an aircraft. One way of addressing this type of situation may be to increase the number of hours spent using certain training solutions and practicing the skills that need to be acquired or improved. This may not be the most optimal solution for several reasons: excessive additional time may not be available to the PUIs, there may not be instructors available to oversee that training, training system may not be available in abundance (examples: flight simulators and aircraft) or financial constraints may prevent using training solutions that consume significant amounts of resources (logistical, human, material). An alternative way of approaching this type of situation is to develop a supplementary training solution that uses commercial off-the-shelf (COTS) systems and is designed to address a specific training gap identified between two consecutive training evolutions that constitute current practice. This paper presents the elements of one such effort. The text elaborates the details of all activities that preceded the actual design of the novel training solution, the governing decisions that influenced the final version of the prototype as well as the results of the feasibility study and demo that were done with a group of subject matter experts to gain informal feedback about the system.

FAMILY OF TRAINING SOLUTIONS AND COMMERCIAL OFF-THE -SHELF SYSTEMS

The training needs of human operators can be addressed by using a variety of solutions that leverage different types of media, training approaches and systems. When it comes to computer based training systems, current practice in many segments of the military domain show that different systems get acquired independently of each other, with little or no expectation directed towards the ability of those systems to look, feel or act as if they belong to the same family of training solutions. This, however, has consequences. A variety of systems will have a variety of user interfaces which support different interactive modalities, making the job of learning those systems far more demanding. In some cases the complexity of the system's interface can easily render that solution unusable by masses of potential users - it is likely that masses of adopters will not have the time and perseverance to learn how to use a complex system. If that training solution is optional to the users (i.e. the use of that system is not mandatory), there is high likelihood that adopters will choose another training approach that they are already familiar with. The complexity of the system is one of the factors that can influence adoption of a new system (Rogers, 1995). It is therefore this phenomenon - the adoption of new solutions by a large number of intended users - that is of primary concern. If a set of training solutions looks, feels and acts like a family, i.e. if knowledge about the interface and data sets in one system can be easily re-used in another system, this will potentially make the transition to the new system much easier. The '*perceived attributes of innovation*' is one element of Diffusion of Innovation Model (DIM) by Everett Rodgers (Rogers, 1995); the same element has also been included in the Training-Centered Diffusion of Innovation Model - TC-DIM (Sadagic and Yates, 2015). The impact that user-perceived usefulness of innovation, its ease of use and final user acceptance, can have on adoption of innovation has been acknowledged in models of adoption proposed by other authors (Davis, 1989)(Davis 1993)(Venkatesh and Davis, 2000)(Venkatesh et al., 2003). A standing assumption, of course, is that the new training solution is proven to be effective.

We identified several attributes as significant if solutions are to be represented as a family of training solutions:

1. They constitute **effective bridges between training phases**. The systems fill the training gaps and they support effective transition between different phases of existing training regimen of one or a group of users (building block approach). One training system may fill multiple training gaps of intended users i.e. it could be used as a training system of choice at different places in an existing training regimen.
2. There is **constancy in look and feel** across the family or training solutions. Whenever appropriate and justified by the objectives of the training system, an effort should be made to insure that interfaces across different systems are similar in terms of how they look and feel to the user (trainee). Not only would it take less time to learn different solutions, the similarity in look and feel would also enhance the sense of their mutual connectedness and support, and in the way indirectly support their adoption by intended users.
3. There is **constancy in interactive modalities**. An additional factor in reducing the learning curve relies on the user's ability to bring their knowledge of interactions and interactive modalities learned in one system, and use it in another system. Contemporary user interfaces overwhelmingly accept this strategy - going against well-accepted types of interactions would only result in confused and unhappy users (Example: A hand gesture for zooming in on a variety of touch-screen solutions is kept exactly the same).
4. They preserve **compatibility with existing systems**. This attribute is predominantly concerned with the systems' ability to produce (consume) information and data sets that could be used (produced) by other systems in the same family of training solutions. Using data formats that can be exchanged between different systems represents a considerable advantage.

An additional factor that was reviewed in the context of our research effort was leveraging of Commercial Off-The-Shelf (COTS) systems. This characteristic not only brings the advantage of users' familiarity with those systems and easy availability of repair services for system components, but it many cases it also directly affects the affordability of those solutions. The price of the final solution will inevitably play a significant role when a decision about new training solutions has to take into consideration a potentially large number of users who will have to get access to that training system. There are, for example, squadrons that have already been issued tablets or Electronic Kneeboards (EKB); the same hardware platforms could serve to support a whole range of training solutions, and leverage the considerable investment that was made to purchase the original platform. Similarly, there are software development environments that allow building applications that can run on different operating systems, making it easier (and cheaper) to develop the same application for a variety of platforms and operating systems.

CLOSE AIR SUPPORT AND TASK ANALYSIS

Close Air Support (CAS) operation is an "Air action by fixed- and rotary-wing aircraft against hostile targets that are in close proximity to friendly forces and that require detailed integration of each air mission with the fire and movement of those forces. Also called CAS." (Joint Pub 1-02). These types of operations are conducted in highly demanding, dynamic environments, and a pilot's ability to maintain a high level of situational awareness throughout individual CAS missions can mean the difference between life and death. Two factors have been identified as most critical for the success of CAS missions: communication between the Joint Terminal Attack Controller or Forward Air Controller and Close Air Support provider, and the capabilities of the aviator/CAS platform. The training community has recognized that training of complex CAS operations needs to happen in a staged fashion. The tasks of the pilots under instruction (PUIs) need to be efficiently broken down, and they have to be able to conduct the repetitious training that is essential for the effective skill acquisition and proficiency of the aviator.

Current training regimen in support of CAS operations includes a variety of ground-school type training sessions: classroom lectures, walk-throughs, talk-through, chalk talks, chair flying, additional reading assignments, and quizzes. In addition to this training, PUIs will also use flight simulators, which represent the usual training step before they fly an aircraft. The overwhelming understanding that exists in this community suggests that there is a discrepancy in terms of the skills acquired in ground-school type of training, and the skills needed to conduct effective training in flight simulators (detailed analysis of this topic is presented in the section "User Study: User Attitudes Regarding Current CAS Training Practices"). Very specifically, the full range of skills needed to operate a flight simulator and execute a scenario presented in the flight simulator, include communications, procedures, tactical decision-making, flying the aircraft and weapon system employment (to mention only the most significant ones); the full skill integration that was requested at this point was perceived as a large step for PUIs. An alternative approach that was advised, and which was exploited in our work, was to develop a part-task trainer that would allow an aviator to practice a subset of those skills first, and only then proceed to a training solution that expected and supported integration of additional tasks and skills. The user study that we conducted with IPs and PUIs allowed us to identify two categories of skills that were perceived by both groups as a training deficiency of PUIs - those were CAS communications, and procedures. The next step that needed to be done was to conduct a task analysis of CAS operations that would be focused only on CAS communications and procedures.

Tasks analysis (TA) is done in situations when a detailed account - a comprehensive understanding about the task - needs to be acquired. This includes breaking down tasks into a series of steps, understanding their order and relative importance, understanding the sensory cues that are present in each step, and the environmental conditions in which the task is normally performed, characteristics of the human operator (including but not limited to skill sets they need to have to perform the task), standards of performance (for humans and the system, if some system or tool is used), interaction and communication with other human operators (if any), and use of other tools to perform the task.

Before we started designing the prototype part-task training system, we executed tasks analysis of CAS operations. Additionally, the AH-1W Training and Readiness (T&R) Manual (NAVMC 3500.49A) was consulted to ensure that the training objectives currently put in place for the CAS stage of training are preserved; this included the "Performance Standards" section, as well as discussion items for each flight conducted within the 3000 level CAS phase of training. Being that the part-task trainer was not focused on acquisition of skills that were aircraft specific (e.g., weapons employment), those performance standards were removed. The remaining performance standards were common to all flights in the 3000 CAS phase: "PUI (Pilot Under Instruction) shall conduct all missions utilizing CAS procedures and communications" (Department of the Navy 2014, 2–88). An additional publication - Naval Tactics, Techniques, and Procedures for the AH-1 (NTTP 3.22-3 March 2013) - was also reviewed for specific information in section "Close Air Support Execution and Mechanics." The communication and procedures connected with the CAS mission that were detailed in that section, were examined using the "Execution Template" from the Joint Publication 3-09.3 close air support. This process produced a detailed understanding about a set of tasks - CAS communications and procedures - that aviators would need to practice while at that stage avoiding a full spectrum of tasks they would do if they were to fly in the actual aircraft (flying an aircraft and conducting weapon system employment). Full details about the results of the tasks analysis can be found in (Attig, 2016).

USER STUDY: USER ATTITUDES REGARDING CURRENT CAS TRAINING PRACTICES

The main objective of this study was to acquire a comprehensive understanding about current CAS practices from the perspective of the training community - both IPs and PUIs. Very specifically, the focus of this study was on effectiveness of individual training approaches, training gaps and difficulties that the training audience may have experienced when using the training solutions that are currently available. An additional emphasis was on collected information about the features and elements of a future training system that prospective users might desire in a part-task trainer. We were also interested to see if there were differences in opinions between instructors and trainees.

Methodology

The user study was organized as an online survey. This allowed easy access to both instructors and trainees - they were stationed in different parts of the country and this was the only way in which all of them could be reached. A limited numbed of in-depth discussions were conducted with subject matter experts; the goal was to check any assumptions that may have been used in this effort, and to validate the results of tasks analysis conducted before the actual design of the part-task trainer. User study included a complete set of Institutional Review Board documentation and full scrutiny of that process. The participation of all individuals was on voluntary basis, anonymous, with no rewards given for participation, and with opportunity to withdraw from the survey at any point.

Apparatus and Participants

LimeSurvey was used to facilitate development of the survey questionnaire and conduct the online survey. All data were stored on the Naval Postgraduate School LimeSurvey server, ensuring full protection and controlled access to the survey data. The final data set included responses collected from 31 instructors (IPs) and 31 trainees (PUIs). Table 1 illustrates basic demographics data of all participants in the study.

Table 1. Demographics Data: IPs and PUIs

	Billet		Geographic Location		
	MAWTS	Squadron	East Coast	West Coast	Hawaii
IPs	9	22	15	15	1
PUIs	24	7	22	7	2

The data sets collected in the online survey suggest that that main difficulties experienced by PUIs during their first CAS flights were communications, situational awareness, and target correlation (Figure 1). It is of note that PUIs listed “target correlation” more than any other difficulty - 18 PUIs selected it, while the same issue was selected by only five IPs. The knowledge of procedures was also prominent in the final results. There was also general agreement among the IPs and PUIs that the 'chalk-talk' technique was the most effective supplemental technique for preparing PUIs for CAS flights (Figure 2). Additionally, communications and CAS procedures were listed as the two most significant reasons for using the 'chalk talk' training technique (Figure 3). A full account of all results of the online surveys collected in this user study can be found in (Attig, 2016).

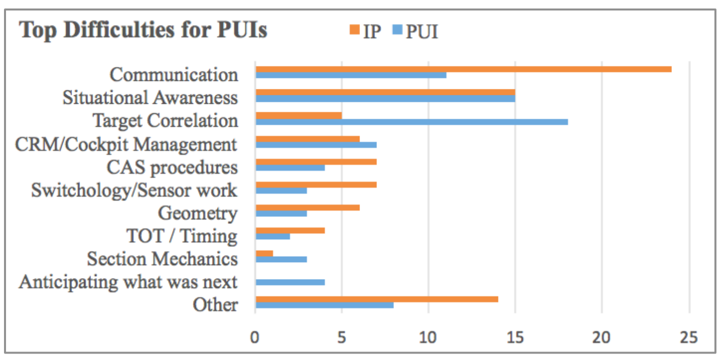

Figure 1. Top Difficulties for PUIs during first CAS flight

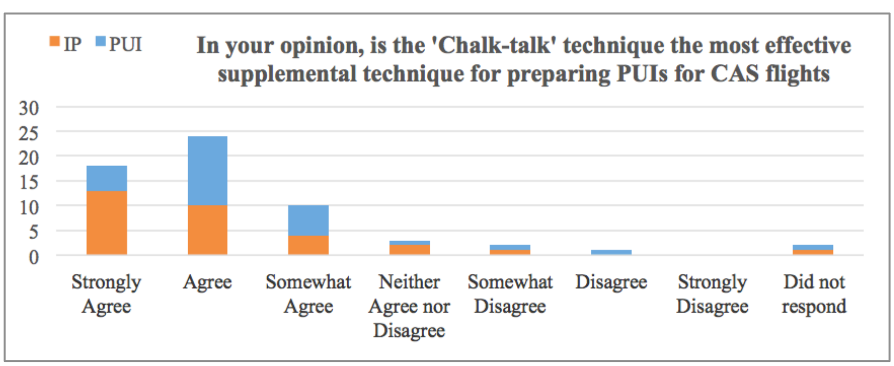

Figure 2. Opinion of Chalk Talk Effectiveness by PUI and IP

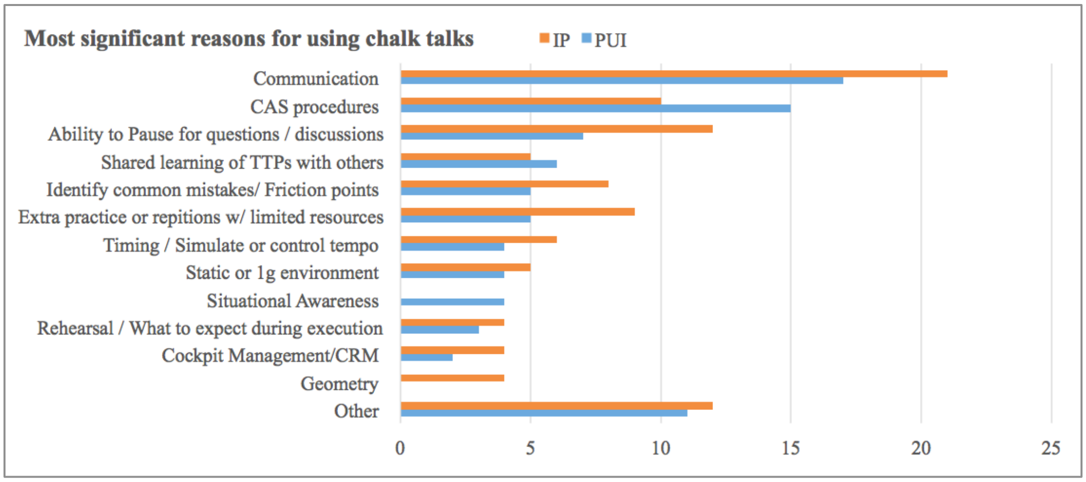

Figure 3. Most Significant Reason IPs and PUIs Use Chalk Talks

PROTOTYPE PART-TASK TRAINING SYSTEM

The main purpose of part-task training system described in this paper is to enables repetitive, individual training of CAS communication and procedure skills similar to "chair flying", and combine them with tactically correct examples of CAS missions. This training system is not designed to serve as a replacement for current training methods used in CAS syllabus. Instead, it is seen as an addition to the repertoire of resources available to PUIs in CAS training. A specific skill set targeted with this training solutions are procedural and communication skills, with the ultimate goal of getting better prepared for training events conducted in the full motion simulator and aircraft.

System Architecture

The prototype part-task training system had two categories of users - instructors (IPs) and trainees (PUIs). Each user category needed different system functionality: IPs had to be able to quickly build and save scenarios that could then be used by PUIs in their training, and PUIs had to be able to view elements of the scenarios designed by the IPs, and respond to questions set by the IPs. The scenario data and associated audio files, which were exchanged between IPs and PUIs, were saved in a file using JavaScript Object Notation (JSON) format. Figure 4 shows a set of functions provided through each independent interface.

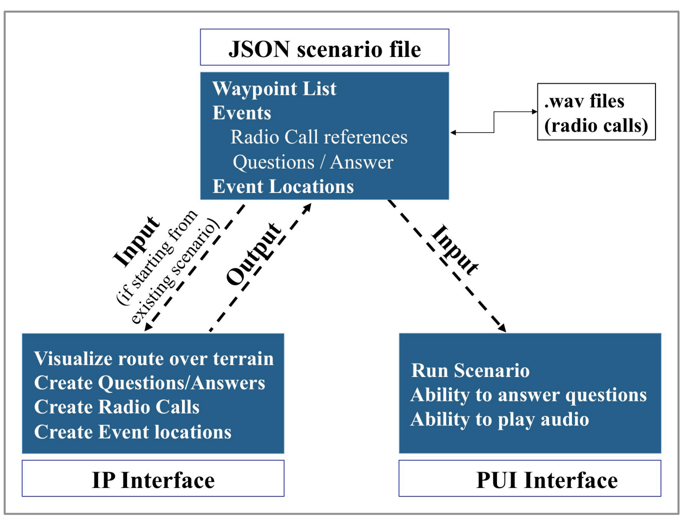

Figure 4. System Architecture

IP and PUI User Interfaces

An independent application - mission planning software called KILSWITCH that runs on Android tablets - is typically used by pilots to create a flying route expressed in Latitude and Longitude format. This information is ingested via an IP interface (Figure 5) and converted to a coordinate system supported in Unity. Each leg of the flying route is given a unique segment ID.

Manipulation and selection of three-dimensional (3D) objects on a two-dimensional screen (2D) is considered to be a non-trivial task. To make this process easier typically more than one view of the 3D scene is used. The ease of manipulation with 3D objects by the instructor was therefore the main reason why the IP interface included two different views of the terrain and a graphical visualization of the route in each view. The lower portion in Figure 5 shows both views - lower left side quadrant shows a top down view of the terrain and the route, and lower right side quadrant shows a view with an adjustable viewing position and its angle ('camera'). The instructor can use the functionalities of the IP interface to create a new training event. In that process any location along the route segment can be selected. An event location can have either a radio call or a pop-up question that the IP designs to test the PUIs knowledge of the plan and CAS procedures (Figure 6). The instructor can record and name new a radio call or use a previously recorded radio call. Figure 6 shows the process of creating a pop-up question: “Create Question Text” button is selected and a pop-up window appears, the instructor types in the text of the question, up to four multiple choice answers and indicates which answer is correct (this, of course, can be changed if a large number of answers need to be presented to the PUI).

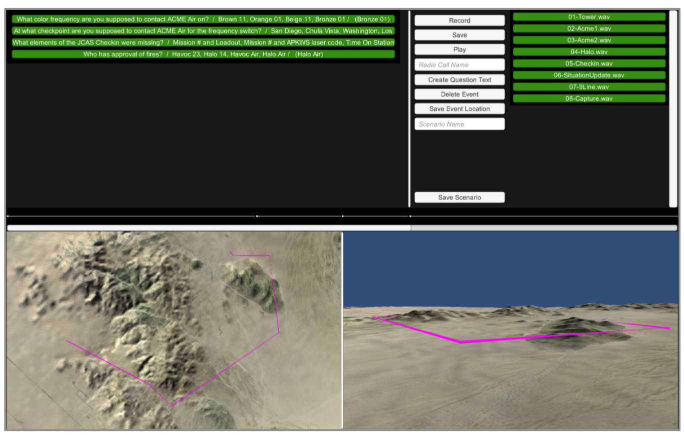

Figure 5. IP User Interface

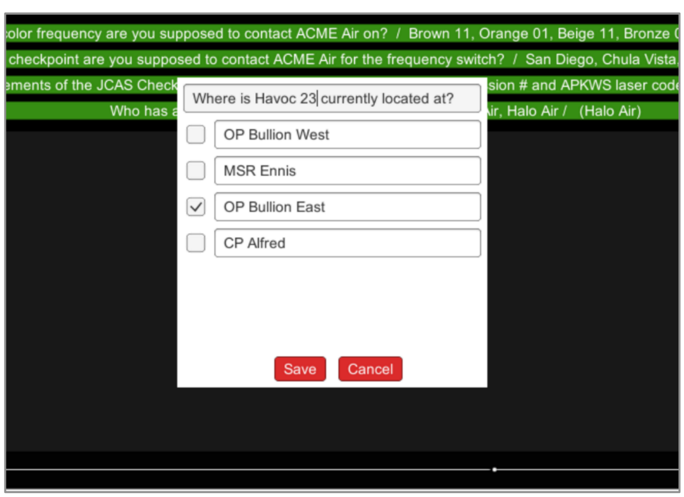

Figure 6. “Create Question Text” Pop-up Window in IP User Interface

The actual event locations were not visible to PUIs when they viewed and ran scenarios using the PUIs interface (Figure 7). During the execution of the training scenario, the system would identify the moment when the aircraft would encounter each event location as they were spread along the flying route. This would trigger the event - a radio call would be played or a pop-up question would be presented to the PUI. The lower left corner in Figure 7 shows an example of a pop-up question on the PUIs screen. The interaction convention that was adopted for this application assumed that automated forward movement of the aircraft is paused until PUI answers the question and selects the 'Continue' button.

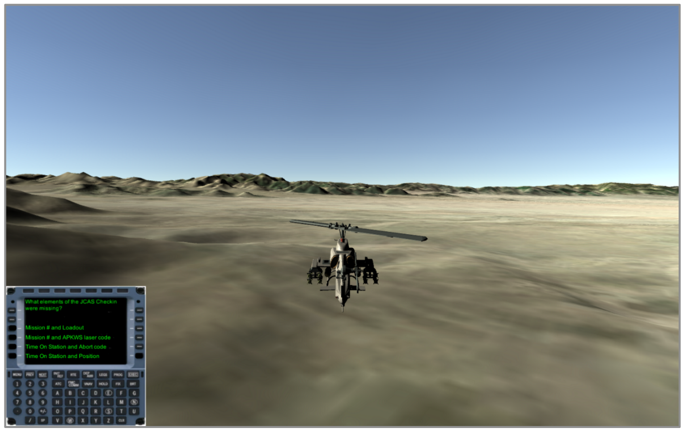

Figure 7. PUI Interface and Pop-up Question Event

Programming and Development Environment

A search for an optimal development environment included tests of Virtual World Sandbox from Advanced Distributed Learning (ADL) and Google Earth, however neither of them fulfilled all the needs of the planned training application. The Unity game engine was the final system of choice - it supported the work with three-dimensional environments. The system also had substantial online technical support and resources and plug-ins from its “Asset store” that considerably sped up the development process. An additional benefit was the ability to build applications for a wide variety of operating systems - this was one of the user requests that was identified during our user study.

The prototype was built as a Windows application. The hardware platform used to run this application was a Window Surface Pro 3 with Windows 10 and an Intel Core i5-4300 CPU with 8GB of RAM. The Unity game engine was used to create the terrain and the 3D environment with the necessary functions. The 3D environment depicted the terrain from Twentynine Palms that covered an area of 64.5 km x 64.5 km. The aircraft model that was used in PUIs interface was an AH-1W Super Cobra. The 3D model of the aircraft was acquired through the MOVES Scenario Authoring and Visualization for Advanced Graphical Environments (SAVAGE) repository (Figure 8). The model was comprised of 26,247 vertices and 28,558 faces.

Figure 8. AH-1W Super Cobra Model: 26,247 vertices and 28,558 faces

FEASIBILITY STUDY

Goals, Methodology and Scope

The overall goal of the feasibility study was to collect objective information about the system performance and acquire an initial understanding about the users' impressions regarding the functionalities, look and feel of both interfaces. While a formal user study would be preferable, this type of feasibility study was seen as a necessary step - a prototype - that helped uncover the most obvious faults, but also elicited early reactions from potential users. An informal demo with discussion was organized with five aviators in Twentynine Palms.

System Performance

The frame rate that the final system was capable of generating ranged between 44 and 60 frames per second (FPS) with the lowest observed frame rate of 38 FPS. The 3D scene included the terrain and a single animated helicopter (shown in Figure 8). The system was designed to use the interactive touchscreen capabilities of the Surface Pro 3, as well as a wirelessly connected mouse to support a range of user interactions.

Informal Demo With IPs and PUIs

A total of five aviators - two IPs and three PUIs - had the opportunity to see and discuss general ideas about the part-task trainer, and two user interfaces. The system demo was conducted in a classroom with the visual interface being projected on a large screen (Figure 8).

Figure 8. Demo of IP Interface (left image), and PUI Interface (right image)

IPs and PUIs' Feedback

The following remarks and suggestions were generated by the IPs that were in attendance:

- **COTS training platforms** and **self-supported training** are desired**.** There was a clear preference for the COTS platforms and the self-supporting nature of the operation, versus a special stand-alone device that would need to be checked out or require a civilian contractor to create training scenarios.
- IPs liked having a **scenario repository**. It was recommended that Marine Aviation Training System Sites (MATSS) could serve as the initial locations were scenarios would be generated for PUIs.
- Having a **terrain databases** was also desirable. A need for a variety of terrain sets was indicated.
- **Increasing the level of realism** was recommended. IPs suggested adding the capability of conducting an actual attack, and visualizing the impacts and smoke that get generated from weapons systems.
- IPs stated that integrating **text-to-speech conversion** for scenario input would be very helpful - it would make the process of creating radio calls much easier. This, however, may need to be re-evaluated before introducing such a system capability. Current text-to-speech applications generate uniform if not monotonous speech patterns, which may detract from the much-needed realism of the scenario (example: voices that reflect different emotional and cognitive states that aviators would exhibit in operational conditions). Realistic sounding human voices with specific voice inflections and pitch in communication

calls, are preferred options in training of PUIs, and IPs may reject anything that diminished this type of impression.
- **Support for different mission sets** was also suggested. Those included the Strike Coordination and Reconnaissance (SCAR) and Armed Reconnaissance (AR) sets.

The following remarks and suggestions were generated by the PUIs:
- PUIs suggested adding **a smart pack** to complement a given scenario. This smart pack could include some documents that are typically made during mission planning for actual flights (an Objective Area Diagram or coversheet that might include call signs, frequencies, timelines, etc.)
- It was advised to introduce **support for smaller subset of training evolution**. It was suggested that the system support not only CAS missions, but also smaller subsets of training evolutions which may occur before or during the conduct of a CAS mission. Examples include demonstrations of how Tactical Video Down Link (TVDL) RIO would sound on the radio, or contingencies such as a Buddy Lase.
- PUIs also suggested adding interface features such as a **Moving Map Display** and **Multi-Functional Displays (MFD)**. This capability would represent customization of the basic (and very general) PUI interface; it would become more aircraft specific as each aircraft has different system displays and capabilities.
- PUIs expressed interest in system **s**upporting **different 3D models of the aircrafts** to reflect different TMS aircraft in the squadrons. This type of addition to the part-task training system would be trivial.

FUTURE WORK

There are several lines of work that have been considered as future extensions of this research effort. The first and easiest to address is a further refinement of both user interfaces; this includes improvement of visual design and adding the functions that further empower both users. An example of that effort is the ability to define multiple events that would run concurrently. This would allow IP to define more complex scenarios and replicate the complexity of real situations that aviators find themselves in when they receive radio calls over multiple radios simultaneously. The IP interface could also allow instructors to select waypoints on flying route i.e. to build new or modify existing routes; currently the routes get created as KML files in KILSWITCH or Google Earth applications and are read by the part-task trainer. Integration of an intelligent tutoring capability is another development that would likely be suggested in the future. While some instructors would still be available to support training with this type of part-task trainer, the essence and the real power of this type of training environment lies in the fact that they could be used by trainees at any time they have available for training. During those training moments there are no guarantees that instructors would be available. Once the work on improving user interfaces is complete, it is recommended that a formal usability study be conducted focused on learnability, effectiveness, efficiency and user satisfaction with both user interfaces. The final effort that needs to be included before any training solution is delivered, is a training effectiveness study that would test training benefits of the part-task trainer.

CONCLUSION

A training gap that exists in CAS syllabi between ground-school type training sessions and the time they embark on training with a flight simulator has been identified in the community - PUIs feel a need for additional training before their first CAS flight in an aircraft. The analysis of self reported data that have been collected in our user study clearly indicates that communications and procedures represent the major difficulties PUIs experience early in their CAS syllabus. It is of note that both instructors (IPs) and trainees themselves (PUIs) agree on this. Both categories of users also agree that the chalk talks represent the most effective supplemental training technique currently available to the aviators. All those findings were exploited and leveraged in the design of the part-task trainer focused on CAS procedures and communication presented in this paper. Two additional elements that were leveraged were commercial off-the -shelf (COTS) systems, to help ensure cost-saving and increase the possibility for larger adoption among intended users, and virtual environments that support higher levels of visual realism and a sense of presence during training sessions. This type of training solution allows aviators to practice CAS communications and procedures at their own pace, and in as many repetitions of training scenarios as they feel are needed.

We believe that once fully developed, this approach holds the promise of providing more effective training while preserving all the advantages of the part-task trainer. The request by the user community to create and share scenarios with other trainees, and to do all that in a self-supporting fashion that does not require additional technical support, is a very good indicator of the maturity and self-reliance that users came to appreciate and expect in the next generation of training solutions. Advances in user interface design (interfaces being overwhelmingly easier to learn and use) and increased experience and skills that users have with a range of applications they use in their non-professional lives, provide additional reassurance that the era of training solutions that champion self-supporting practices and low maintenance training environments, has already begun.

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